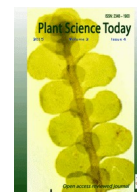




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Research Communication

Moss flora of Rajasthan and Punjab plains

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Abstract

An updated account of 51 taxa of mosses of Rajasthan and Punjab plains is provided along with a note on delimitation of boundaries of this unique bryo-geographical zone. Family Pottiaceae is most dominant and diversified with 17 taxa under 11 genera while genus *Fissidens* (Fissidentaceae) has the maximum diversity with 7 species followed by *Physcomitrium* (Funariaceae) and *Bryum* (Bryaceae) with 6 species each.

Keywords

Bryophytes; Flora; Moss; Punjab; Rajasthan

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Introduction

Pande (1958) proposed floristic division of India into seven bryo-geographical zones to study the enormous bryo-floristic wealth of country namely (i) West Himalayas, (ii) East Himalayas, (iii) Gangetic plains (iv) Panjab and west Rajasthan plains (v) Central India (vi) Western Ghats and (vii) Eastern Ghats and Deccan plateau (Fig. 1). However, he made the division by thick lines, hence; significant problem arose while discussing the distribution of various taxa due to somewhat ill-defined boundaries of various zones (Alam *et al.*, 2015). In our earlier attempt to solve this problem, boundary of 'Central Indian bryo-geographical zone' was proposed along with a checklist of mosses in the area (Alam *et al.*, 2015). In continuation of the same, the present paper not only proposes the boundaries of 'Rajasthan and Punjab plains bryo-geographic zone' for ease in distributional analysis but also provides updated account of mosses present in this zone.

Instead of west Rajasthan (as named by Pande) it is recommended that entire Rajasthan except south

Rajasthan (Fig. 2) to be included in this zone. South Rajasthan is a part of Central Indian zone (Alam *et al.*, 2015) and therefore excluded. The Rajasthan plain is a unique zone particularly due to presence of 'Thar desert' having its own exclusive desert vegetation. Owing to the dry climate and desert conditions, very low number of bryophyte has been reported from this area.

On the other hand, the Punjab plains broadly consists present Punjab and Haryana states. This part of India is made up of alluvial soil brought by Indus and its tributaries, harbouring its own unique flora. However, some parts of this zone contain highlands (particularly Dhar tehsil in Pathankot district of Punjab and Morni hills in Panchkula district of Haryana) which need to be treated under western Himalayan zone. Kashyap (1929, 1932) though published his monumental work on "Liverworts of Western Himalaya and Punjab plains", however; so far the moss flora of this zone has remain neglected.

Furthermore, the status of Delhi is also questionable. Though treated as a part of Gangetic plains, geo-physical position of Delhi favours its

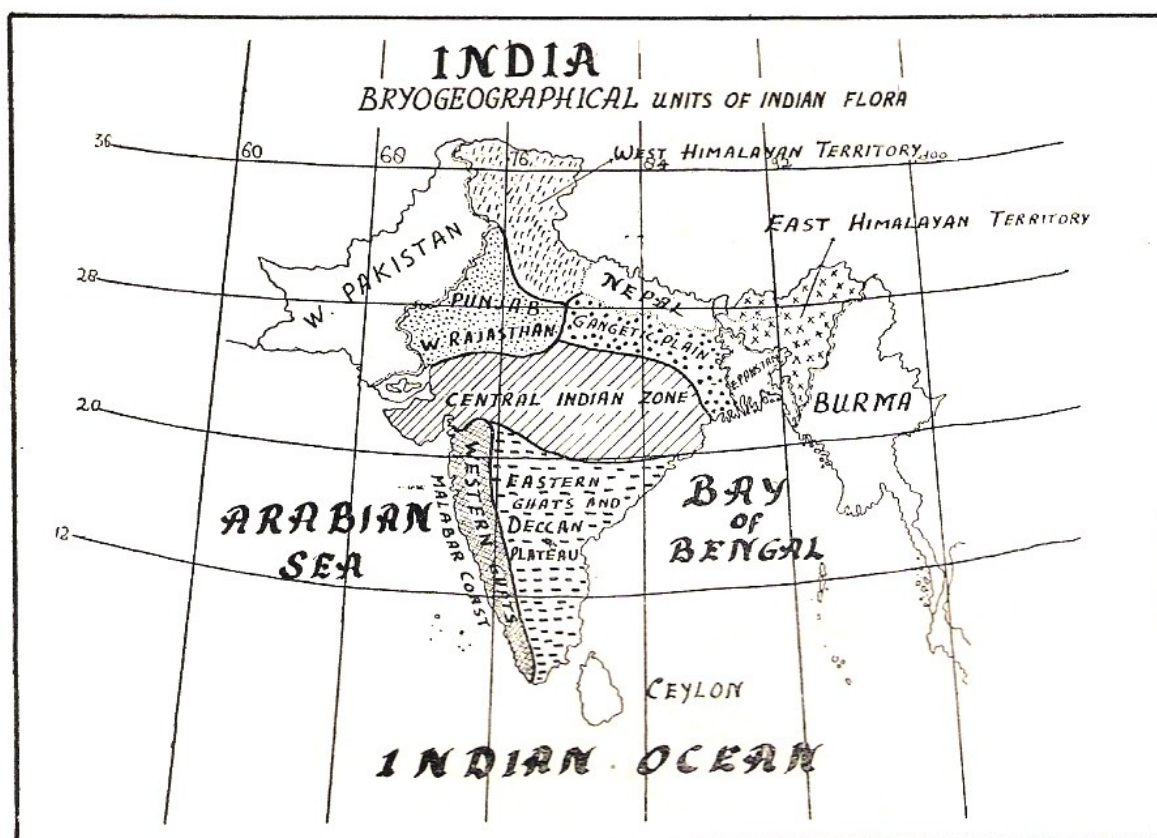


Fig. 1. Bryo-geographical territories of India proposed by Pande (1958) [Figure from "The Journal of the Indian Botanical Society 37(1):10, 1958"]

placement in Punjab plains along with Punjab and Haryana, as it is surrounded from three sides by Haryana. Yamuna river, which marks the western boundary of Gangetic plains as well as Delhi ridges (northern most end of Aravali hills) also separate most of the area of Delhi from Gangetic plains. However, East Delhi or Shahdara zone dissected out by river Yamuna, need to be treated within Gangetic plains.

Hence, in present work we propose Rajasthan (except south Rajasthan including Banswara, Sirohi, Udaipur, Rajsamand and Pali districts), Punjab (except Dhar tehsil of Pathankot district), Haryana (except Morni hills area in Panchkula district) and Delhi (except East Delhi) as parts of 'Rajasthan and Punjab plains' that should be considered as a single bryo-geographic zone.

By and large, this zone has been usually ignored in comparison to other bryo-geographic zones. Rajasthan, the most studied area, too had most of the studies focused in south Rajasthan (Central Indian zone), hence bryological records from other parts of the zone are negligible or meager. The present document provides updated accounts of 57 taxa of mosses from this zone. Distributional details with relevant references are also given, which may be useful for future workers and will encourage bryo-floristic studies in neglected areas.

Materials and Methods

The present compilation is based on the all available literature till date from above mentioned bryo-geographical zone. The taxa reported without species

epithet, have been excluded. The accepted names are cited in bold. Format of the enumeration of taxa follows Alam et al (2015). The classification scheme follows Goffinet et al. (2008).

Summary of mosses of Rajasthan and Punjab plains:

- Family Amblystegiaceae:** *Drepanocladus* (1)
- Family Bartramiaceae:** *Philonotis* (1)
- Family Bruchiaceae:** *Trematodon* (3)
- Family Bryaceae:** *Brachymenium* (1) *Bryum* (6)
- Family Ditrichaceae:** *Ceratodon* (1)
- Family Fissidentaceae:** *Fissidens* (7)
- Family Funariaceae:** *Entosthodon* (1) *Funaria* (1) *Loiseaubryum* (1) *Physcomitrium* (6)
- Family Hypnaceae:** *Orthothecium* (1)
- Family Leskeaceae:** *Leskea* (1)
- Family Myriniaceae:** *Schwetskeopsis* (1)
- Family Pottiaceae:** *Anoetangium* (1) *Barbula* (2) *Gymnostomiella* (1) *Gymnostomum* (1) *Hydrogonium* (3) *Hymenostylium* (1) *Hyophila* (4) *Pseudocrossidium* (1) *Semibarbula* (1) *Timmiella* (1) *Tortula* (1)
- Family Splachnobryaceae:** *Splachnobryum* (1)
- Family Timmiaceae:** *Timmia* (1)

Enumeration of taxa:

Anoetangium strachyanum Mitt., Musc. Ind. Or.: 31, 1859. RAJASTHAN: Ranthambhore (Alam et al., 2011)



Fig. 2. Map of India showing proposed extent of 'Rajasthan and Punjab plains' bryo-geographical zone.

- Barbula indica*** (Hook.) Spreng., Nomenci Bot. 2: 72, 1824. RAJASTHAN (Lal, 2005)
- Barbula javanica*** Doz. & Molk. in Ann. Sci. Nat. Bot. ser. 3,2: 300, 1884. RAJASTHAN: Ranthambhore (Alam *et al.*, 2011)
- Brachymenium exile*** (Dozy & Molk.) Bosch & Sande Lac., Bryol. Jav. 1: 139, 1860. RAJASTHAN: Ajmer, Pali-near Harganga, (Chaudhary and Deora, 1993) DELHI (Chopra and Kanta, 1966)
- Bryum bicolor*** Dicks., Pl. Crypt. Brit. Fasc. 4: 16, 1801. RAJASTHAN: Jaipur (Bansal and Nath, 2014)
- Bryum bornholmense*** Wink. & Ruthe, Hedwigia 38: 120, 1899. RAJASTHAN: Bikaner (Bansal and Nath, 2014)
- Bryum bornholmense*** Wink. & Ruthe, Hedwigia 38: 120, 1899. RAJASTHAN: Bikaner (Bansal and Nath, 2014)
- Bryum coronatum*** Schwägr. Schwaegr., Sp. Musc. Frond, suppl. 1(2): 103, 1816. PUNJAB: Gurdaspur, Hoshiarpur (Singh *et al.*, 2006) DELHI (Chopra and Kanta, 1966)
- Bryum dichotomum*** Hedw., Sp. Musc. Frond. 183, 1801. RAJASTHAN: Jaipur (Bansal and Nath, 2014)
- Bryum kliggraeffii*** Schimp., in Klinggr., Höh. Crypt. Preuss. 81, 1858. RAJASTHAN: Alwar, Bikaner, Jaipur. (Bansal and Nath, 2014) DELHI (Chopra and Kanta, 1966)
- Ceratodon purpureus*** (Hedw.) Brid., Bryol. Univ. 1: 480, 1826. DELHI (Chopra and Kanta, 1966)
- Drepanocladus uncinatus*** (Hedw.) Warnst., Beih. Bot. Centralbl. 13: 417, 1903. PUNJAB (Lal, 2005)
- Entosthodon nutans*** Mitt., J. Proc. Linn. Soc. Bot., suppl. 1: 55, 1859. PUNJAB and RAJASTHAN (Lal, 2005)

- Fissidens bryoides*** Hedw., Sp. Musc. Frond. 153, 1801. DELHI (Chopra and Kanta, 1966)
- Fissidens ceylonensis*** Dozy & Molk., Ann. Sci. Nat., Bot., ser. 3, 2: 304, 1844. PUNJAB: Ropar (Singh *et al.*, 2006)
- Fissidens crispulus*** Brid., Muscol. Recent Suppl. 4: 187, 1819. RAJASTHAN: Alwar; Kota (Bapna, 1980 and Chaudhary and Deora, 1993 as *Fissidens sylvaticus*) Bhilwara (Chaudhary and Deora, 1993 as *Fissidens sylvaticus*)
- Fissidens curvato-involutus* Dix., Notes Roy. Bot. Gard. Edinburgh 19: 279, 1938. —> ***Fissidens involutus*** ssp. ***curvato-involutus*** (Dix.) Gangulee
- Fissidens diversifolius*** Mitt., J. Linn. Soc. Bot., suppl. 1:140, 1859. RAJASTHAN: Kumarwara (Bapna, 1980) Sawai Madhopur, Kota, (Chaudhary and Deora, 1993)
- Fissidens gemminiflorus*** Doz. et Molk. var. ***nagasakinus*** (Besch.) Iwats. Jour. Hattori Bot. Lab. 32: 272, 1969. RAJASTHAN: Gorham ghat, Kota-Dhara hills; (Bapna, 1980) Gorham ghat, Bhilwara, (Chaudhary and Deora, 1993)
- Fissidens involutus*** ssp. ***curvato-involutus*** (Dix.) Gangulee, Mosses E India 2: 548, 1971. RAJASTHAN: Ajmer, Chittorgarh, Jaipur (Bapna, 1980; Chaudhary and Deora, 1993 as *Fissidens curvato-involutus* Dix.)
- Fissidens sylvaticus* Griff., Calcutta J. Nat. Hist. 2: 507, 1842. —> ***Fissidens crispulus*** Brid.
- Fissidens taxifolius*** Hedw., Sp. Musc. Frond. 155, 1801. DELHI (Chopra and Kanta, 1966)
- Funaria hygrometrica*** Hedw. Spec. Musc. 172, 1801. PUNJAB: Ropar (Singh *et al.*, 2006), RAJASTHAN: common throughout Rajasthan, Bhilwara (Chaudhary and Deora, 1993), Ganganagar (Choyal and Sharma, 2011) DELHI (Chopra and Kanta, 1966)
- Funaria nutans* (Mitt.) Broth. —> ***Loiseaubryum nutans*** (Mitt.) Broth.
- Gymnostomiella vernicosa*** (Hook. ex Harv.) M. Fleisch., Musci Buitenzorg 1: 310, 1904. RAJASTHAN: Ajmer (Chaudhary and Deora, 1993), Ranthambhore (Alam *et al.*, 2011), DELHI (Chopra and Kanta, 1966)
- Gymnostomum aeruginosum*** Sm., Fl. Brit. 3: 1163, 1804. RAJASTHAN (Lal, 2005)
- Hydrogonium consanguineum*** (Thwaites & Mitt.) Hilp., Beih. Bot. Centralbl., Abt. 2, 50(2): 626, 1933. RAJASTHAN: Gangangar, Jhunjhunu, (Chaudhary and Deora, 1993)
- Hydrogonium gangeticum*** (Müll. Hal.) P.C. Chen, Hedwigia 80: 237, 1941. DELHI (Chopra and Kanta, 1966)
- Hydrogonium javanicum*** (Dozy & Molk.) Hilp., Beih. Bot. Centralbl., Abt. 2, 50(2): 632, 1933. PUNJAB and RAJASTHAN (Lal, 2005)
- Hymenostylium recurvirostrum*** (Hedw.) Dixon, Rev. Bryol. Lichenol., 6: 96, 1933. RAJASTHAN: Kota (Bapna and Choudhary, 1989), PUNJAB (Lal, 2005) DELHI (Chopra and Kanta, 1966)
- Hyophila comosa* Dixon et P. de La Varde, arch. Bot. 1: 166, 1927. —> ***Hyophila rosea*** Williams
- Hyophila involuta*** (Hook.) A. Jaegr., Ber. S. Gall. Naturew. Ges. 1871-72: 356, 1873. PUNJAB: Gurdaspur (Singh *et al.*, 2006) RAJASTHAN: Alwar, Jaipur, Kota (Bapna and Choudhary, 1989), Jhunjhunu (Chaudhary and Deora, 1993), Ranthambhore (Alam *et al.*, 2011).
- Hyophila nymmaniana*** (M. Fleisch.) M. Menzel, 22: 198, 1992. RAJASTHAN: Ranthambhore (Alam *et al.*, 2011)
- Hyophila rosea*** Williams, Bull. N.Y. Bot. Gard. 8: 341, 1941. RAJASTHAN: Menal near Bhilwara (Chaudhary and Deora, 1993)
- Hyophila spathulata*** (Harv.) A. Jaeger., Ber. Thätigk. St. Gallischen Naturwiss. Ges. 1871-72: 353, 1873. DELHI (Chopra and Kanta, 1966) Ranthambhore (Alam *et al.*, 2011)
- Leskea nervosa*** (Brid.) Myrin., Coroll. Fl. Upsal. 52, 1834. PUNJAB (Lal, 2005)
- Loiseaubryum nutans*** (Mitt.) Fife., J. Hattori Bot. Lab. 58: 192, 1985. PUNJAB (Chaudhary and Deora, 1993 as *Funaria nutans*) RAJASTHAN: Jaipur – Sawai Madhopur (Robinson, 1968 as *Funaria nutans*)
- Orthothecium intricatum*** (Hartm.) Schimp., Bryol. Eur. 5: 108, 1851. Punjab (Lal, 2005)
- Philonotis angusta*** Mitt., J. Proc. Linn. Soc., Bot., suppl. 1: 61, 1859. PUNJAB: Gurdaspur (Singh *et al.*, 2006)
- Physcomitrium coorgens*** Broth., Rec. Bot. Surv. India 1(12): 319, 1899. DELHI (Chopra and Kanta, 1966; Lal, 2007)
- Physcomitrium cyathicarpum* Mitt., J. Proc. Linn. Soc., Bot., suppl. 1: 54, 1859 —> ***Physcomitrium immersum*** Sull.
- Physcomitrium eurystomum*** Sendtn., Denkschr. Bayer. Bot. Ges. Regensburg 3: 142, 1841. PUNJAB: Hoshiyarpur (Singh *et al.*, 2006), RAJASTHAN (Lal, 2005)
- Physcomitrium immersum*** Sull., Manual 648, 1848. RAJASTHAN: Jaipur – Sawai Madhopur (Robinson, 1968 as *Physcomitrium cyathicarpum*), PUNJAB (Lal, 2005 as *Physcomitrium cyathicarpum*) DELHI (Chopra and Kanta, 1966 as *Physcomitrium cyathicarpum*)
- Physcomitrium japonicum*** (Hedw.) Mitt., Trans. Linn. Soc. London, Bot. 3: 164, 1891. RAJASTHAN: Alwar (Chaudhary and Deora, 1993)
- Physcomitrium delicatum*** H.A. Crum and L.E. Anderson, Bryologist 58: 1, 1955. DELHI (Lal and Menon 1971)
- Physcomitrium pulchellum*** (Griff.) Mitt., J. Proc. Linn. Soc., Bot. suppl. 1: 54, 1859. DELHI (Vashistha and Chopra, 1983)
- Pseudocrossidium porphyreoneurum*** (Müll. Hal.) R.H. Zander, Bull. Buffalo Soc. Nat. Sci. 32: 119, 1993. RAJASTHAN (Lal, 2005)
- Schwetscheopsis formosana*** Nog., J. Hattori Bot. Lab., 5: 41, 1951. PUNJAB: Gurdaspur (Singh *et al.*, 2006)
- Semibarbula orientalis*** (F. Weber) Wijk. & Margad., Taxon 8: 75, 1959. RAJASTHAN: Alwar (Bapna

- and Choudhary, 1989; Choudhary and Deora, 1993) DELHI (Chopra and Kanta, 1966)
- Splachnobryum flaccidum* (Harv.) Braithw., Grevillea 1(2): 28, 1872 → *Splachnobryum obtusum* (Brid.) Müll. Hal.
- Splachnobryum indicum* Hampe & Müll. Hal., Linnaea 37: 174, 1972 → *Splachnobryum obtusum* (Brid.) Müll. Hal.
- Splachnobryum obtusum* (Brid.) Müll. Hal., Verh. K.K. Zool.-Bot. Ges. Wien 19: 504, 1869. DELHI (Chopra and Kanta, 1966 as *Splachnobryum indicum* and *Splachnobryum flaccidum*)
- Timmia megapolitana* Hedw., Sp. Musc. Frond. 176, 1801. PUNJAB: Gurdaspur (Singh *et al.*, 2006)
- Timmiella anomala* (Bruch & Schimp.) Limpr., Laubm. Deutschl. 1: 592, 188. RAJASTHAN: Ajmer, Chittorgarh, Jaipur, Jodhpur-Mandore, Sawai Madhopur (Bapna and Choudhary, 1989; Chaudhary and Deora, 1993).
- Tortula muralis* Hedw., Sp. Musc. Frond. 123, 1801. RAJASTHAN: Ajmer, Bikaner, Chittorgarh, Jodhpur, Jaipur, Sawai Madhopur (Bapna and Choudhary, 1989; Chaudhary and Deora, 1993)
- Trematodon brevicalyx* Dixon., J. Indian bot. Soc. 4: 287-97, 1925. DELHI (Vashistha and Chopra, 1983)
- Trematodon longicollis* Michx., Fl. Bor.-Amer 2: 289, 1803. PUNJAB: Gurdaspur (Singh *et al.*, 2006)
- Trematodon subulosus* Griff., Cal. J. Nat. hist. Soc. 2: 493, 1842. RAJASTHAN: Ganganagar (Chaudhary and Deora, 1993) PUNJAB (Lal, 2005)
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